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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/810,923 | 03/26/2004 | Christopher J. Lehane | EH-10843 (04-104) | 9383 |

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EXAMINER

ELVE, MARIA ALEXANDRA

ART UNIT PAPER NUMBER

1725

DATE MAILED: 01/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|-------------------------------|-------------------------------|--|
| Office Action Summary | Application No. 10/810,923 | Applicant(s) LEHANE ET AL. | |
| | Examiner M. Alexandra Elve | Art Unit 1725 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 November 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17, 19-27, 29-31, 33-40 and 42-45 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17, 19-27, 29-31, 33-40, 42-45 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 August 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>11/14/05</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-9, 12-17, & 43 are rejected under 35 U.S.C. 102(b) as being anticipated by Liu et al. (USPN 6,720,519).

Liu et al. ('519) discloses a laser system for micromachining, high precision, controlled hole shapes into a workpiece. The picosecond laser system includes the laser, a beam, a first mirror, a shutter, an attenuator, a second mirror, a beam expander, a third mirror, a fourth mirror, a spinning half wave plate, a scan mirror, a DOE (diffractive optical element), a plurality of sub-beams, a scan lens, a microfilter, an image transfer lens (can be a large area CCD) and a workpiece. One example of a workpiece is a turbine blade with drilled cooling channels.

A picosecond laser produces short pulses and a DOE is used to split the beam into a plurality of beams, allowing parallel drilling of the workpiece. Controlled hole shape is obtained by using a scan mirror, a milling algorithm and a picosecond laser. The DOE in combination with the scan mirror with piezo-electric actuators is used to control intensity. The ultrafast laser generates intense laser pulses with durations of 10

picooseconds to 10 femtoseconds. Lasers such as excimer, Q-switched, CO₂ and copper vapor are used. The picosecond laser emits a beam of bandwidth less than 0.1 nanometer. The pulse width is approximately 15 picoseconds, with 1W at 1 kHz. Typically a pulse width of between 1 ps and 100 ps is suitable.

The shutter allows the beam to illuminate the workpiece surface in the open position and prevents illumination in the closed position. Shutter speeds are about 1 ms. Alternate embodiments of fast shutters are external electro-optic modulators such as a Pockels cell, a galvanometer mirror that deflects the beam out of the desired beam path or direct modulation of the Q-switch. The instant attenuator includes a half-wave plate and a polarizer.

The scan lens is a f-theta telecentric lens. The scan lens determines the spot size of the sub-beams upon the workpiece. The beam size that enters the entrance pupil of the scan lens must be less than or equal to the pupil size of the scan lens. Telecentricity is required to keep the incident angle between sub-beams and workpiece perpendicular, which is necessary to drill parallel holes in the workpiece.

Image transfer lens maintains image quality, spot size and telecentricity, while preventing blowback of ablated particles from the workpiece onto the microfilter. The image transfer lens consists of two telecentric scan lenses, identical to scan lens placed back to back, with the pupil planes of the two scan lenses coinciding in the middle. In an alternative embodiment a source of high velocity gas (air or nitrogen) is formed into a laminar flow sheet that passes between the microfilter and workpiece. This flow of gas removes blowback particles before they can be deposited onto the microfilter.

The beam propagates along the optical path, where it is incident upon the first mirror. The first mirror redirects the beam along the optical path, where it is incident upon the shutter. The shutter opens and closes to selectively illuminate the workpiece material. Beams exit the shutter and propagate along the optical path to attenuator. The attenuator filters the energy of the picosecond laser in order to precisely control ablation parameters. Beams exits attenuator and propagate along the optical path, where it is incident upon the second mirror. The second mirror redirects the beam along the optical path, where it is incident upon the beam expander.

The workpiece is mounted on a computer controlled, programmable translation stage. The XY stage implements the laser milling algorithm that moves the workpiece to achieve the desired shape. The milling algorithm is defined and communicated to the picosecond laser drilling system with a computing means such as a computer. The computer sends signals to the shutter and scan mirror.

The microfilter controls and equalizes the intensity distribution of multiple laser beams that can be used to produce laser-milled holes in a variety of geometrically repeatable shapes. The intensity distribution of the sub-beams can be measured and analyzed using a feedback step. Sub-beams exit the microfilter and propagate along the optical path, where they are incident upon the image transfer lens. The image transfer lens re-images the focal spots of sub-beams onto the workpiece. Sub-beams then ablate the workpiece in a pattern according to a pre-defined milling algorithm.

(abstract, figures, col. 1, lines 27-60, col. 2, lines 40-67, col. 3, lines 1-11, 35-40, col. 6, lines 12-60, col. 7, lines 40-62, col. 8, lines 1-49, col. 9, lines 7-67, col. 10, lines 1-61,

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col. 12, lines 34-48, col. 13, lines 19-22, col. 14, lines 60-67, col. 15, lines 1-44, col. 17, line 67, col. 19, lines 4-7, col. 20, lines 25-35, col. 22, lines 1-67)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 10-11, 19-27, 29-31, 33-40, 42 & 44-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu et al. ('519), as stated in the above paragraph and further in view of Liu et al. (USPN 6,621,045) and Boyle et al. (USPAP 2002/0170891 A1).

Liu et al. ('519) teaches the use of lens and gas, but not the focusing of the lens, the pressure of the gas or the use of a chamber.

Liu et al. ('045) discloses laser drilling using ultrafast sub-beams. The sub-beams may be emitted from a beamsplitter and are used to perform parallel laser drilling of a drilling pattern in the targeted workpiece. The sub-beams are focused on the focal plane (135) (figure 1C). Additionally, during processing, a gas flow (air, nitrogen, argon or another inert gas) creates a reduced atmospheric pressure in front of the target area of

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the workpiece. The reduction in atmospheric pressure in the range of 2.7 to 56,000 Pascals. (2.7 Pascals equals 20 mTorr) (abstract, figures, col. 4-5)

Boyle et al. discloses the pulsed laser machining (drilling) of a substrate inside an environmentally controlled chamber. (abstract)

It would have been obvious to one of ordinary skill in the art at the time of the invention to focus the lens on the workpiece and determine the gas pressure, as taught by Liu et al. ('045) in the Liu et al. ('519) system because these are merely standard functions and parameters of the lens and gaseous environment.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use an environmentally controlled chamber during drilling as taught by Boyle et al. in the Liu et al. ('519) system because this ensures quality control of the product, that is, contamination effects are negated.

Response to Arguments

Applicant's arguments with respect to claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to M. Alexandra Elve whose telephone number is 571-272-1173. The examiner can normally be reached on 6:30-3:00 Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

January 20, 2006.



M. Alexandra Elve
Primary Examiner 1725